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(54) Compensation for parasitic capacitances in a screened resistance device

(57) In a method of compensating for parasitic capacitances between a resistor (R_3) and an electrically conducting screening electrode (4), e.g. in a potential divider arrangement (R_3/R_4) for measuring a high voltage (U_H) having alternating voltage, there is used an additional electrode (5) which extends around the resistor (R_3) and has the form of a semi-cylinder produced from a right-angled triangular sheet of electrically conductive material. The part of the current which flows away from the resistor (R_3) due to the alternating voltage between the resistor and the screening electrode, or to the parasitic capacitances, is thus prevented. The other part of this current is replaced through a countercurrent of equal magnitude counteracting the current flowing away.

FIG.3

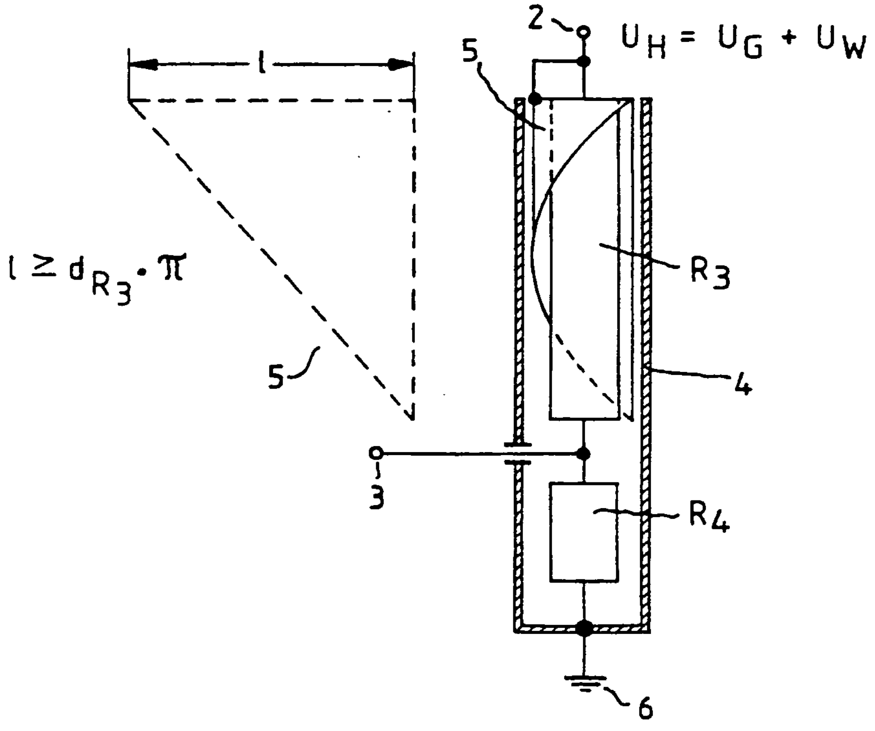

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FIG.1

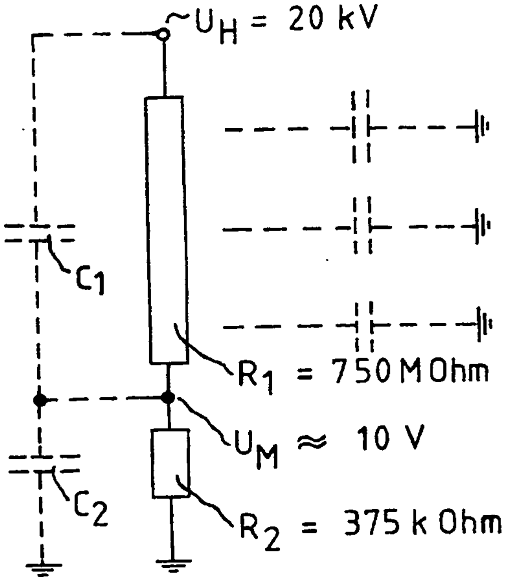


FIG.2

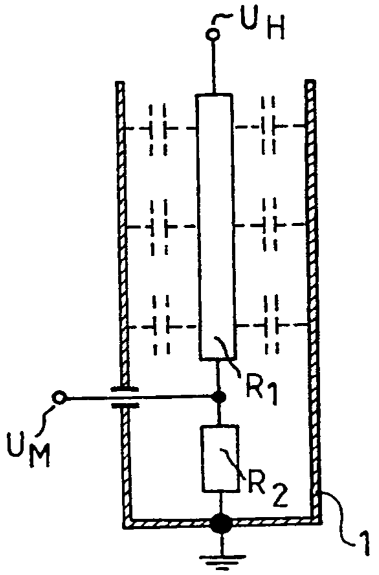
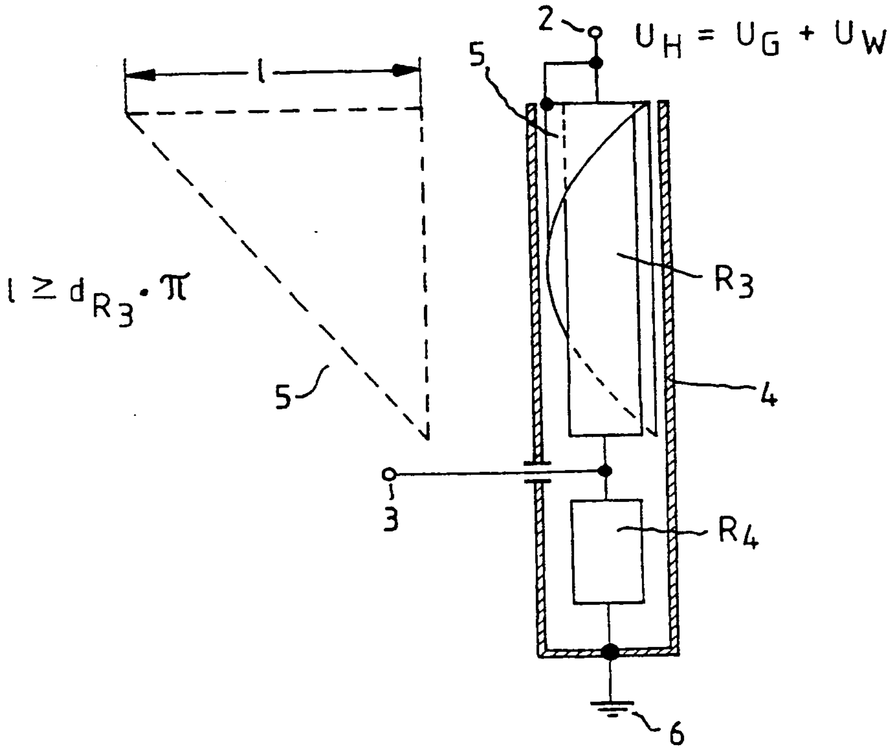


FIG.3



SPECIFICATION

Compensation for parasitic capacitances in a screened resistance device

The present invention relates to a method of compensating for parasitic capacitances between a resistor and a screening electrode and to a screened resistance device in which such compensation is provided.

In some case, voltages are determined by measurement with the aid of a voltage divider. This applies particularly to high voltages. In the case of a simple voltage divider with two resistors, two parallel capacitances occur and the transmission behaviour is usable for dynamic voltage measurements only when the first resistance and associated capacitance form the same time constant as the second resistance and associated capacitance. In the case of a longer resistor, additional parasitic capacitances arise relative to the employed chassis. These parasitic capacitances, which can cause undesired coupling of interference fields into the first resistor and preclude use of the abovedescribed compensation method, can be compensated for through screening of the measuring resistor by means of a guard electrode, such as an electrically conductive screening cylinder which encloses the resistors and lies at zero potential. However, the diameter of the screening cylinder must be so large that only negligibly small parasitic capacitances relative to a chassis arise, because the voltage divider otherwise fails for high frequencies.

There is thus scope for improved measures for compensating for parasitic capacitances between a resistor and a screening cylinder.

According to a first aspect of the present invention there is provided a method of compensating for parasitic capacitances between a resistor to which a voltage with alternating and direct components is applied and a screen electrode lying at zero potential and so arranged in the immediate proximity of the resistor that a current flowing away from the resistor can be generated by alternating voltage between the resistor and the electrode or by parasitic capacitances, the method comprising the steps of preventing generation of part of that current and compensating for the remaining part by generation of a current of substantially equal magnitude and opposite direction.

According to a second aspect of the present invention there is provided a screened resistance device comprising a resistor, a cylindrical screening electrode surrounding the resistor, and an additional electrode arranged within the screening electrode and so adapted in shape to that of the resistor that when the additional electrode lies at high potential the screening electrode has a capacitive effect on the resistor increasing to substantially the same degree as capacitive effect of the additional electrode on the resistor decreases.

The particular advantage of such a device may be that, by contrast to the previous use of a screening cylinder of large diameter or at large spacing from the resistor, a screening cylinder of small diameter or disposed in immediate proximity of the resistor can be used.

An example of the method and an embodiment of the screened resistance device of the present invention will now be more particularly described with reference to the accompanying drawings, in which:

Figure 1 is a diagram of a resistance device of the prior art;

Figure 2 is a diagram of a screened resistance device of the prior art; and

Figure 3 is a diagram of a screened resistance device embodying the invention.

Referring now to the drawings, there is shown in Fig. 1 a voltage divider with resistors R_1 and R_2. The high voltage present at the voltage divider is designated by U_H and the measurement voltage U_M. The electrical voltage and resistance values are also entered in the diagram, for which purpose the measurement voltage U_M has been calculated according to generally known formulae on the presumption of purely ohmic resistances R_1 and R_2.

Moreover, for each resistor R_1 and R_2 respective parallel capacitances C_1 and C_2 are shown in dashed lines. On the occurrence of parallel capacitances of that kind, the transmission behaviour is usable for dynamic voltage measurements only when the capacitance C_1 forms with the resistance R_1 the same time constant $\tau=C_1.R_1$ as the capacitance C_2 with the resistor R_2, i.e. $\tau=C_2.R_2$. In the case of a longer measuring resistance, for example resistor R_1, additional spatially distributed parasitic capacitances arise relative to an employed chassis, these also being illustrated in dashed lines in Fig. 1. These parasitic capacitances can cause coupling of interference fields into the measuring resistor R_1 and make the use of the above-described compensation method impossible. The capacitances can be compensated for through screening of the resistor R_1 by means of a guard electrode. For this purpose there can be used, for example as illustrated in Fig. 2, an electrically conducting screening cylinder 1 which encloses the resistors R_1 and R_2 and lies at zero potential. However, the diameter of the screening cylinder 1 must be so large that only negligibly small parasitic capacitances relative to a chassis arise, or else the voltage divider fails for high frequencies.

In Fig. 3, however, there is shown a screened resistance device for performance of a method exemplifying the invention, this device being a voltage divider which can serve for determination of voltages by measurement. The device comprises a spatially extended resistor R_3 acting as measurement resistance and a smaller resistor R_4 connected in series. A high voltage U_H is present at the high voltage point 2 of the resistor R_3, whilst the measurement voltage U_M can be tapped at a measurement point 3 in the electrical connecting line between the resistors. The other connecting point of the resistor R_4 lies at ground.

The two resistors are surrounded by an electrically conducting screening cylinder 4, through which the measurement point 3 passes and which is electrically conductively connected with the ground line. Arranged within the cylinder 4 is an electrically conducting additional electrode 5, which is spatially matched to the resistor R_3 and lies at high voltage potential through connection to the high voltage point 2. It is constructed in such a manner that the screening cylinder 4 acts capacitively increasingly on the resistor R_3 to the degree that the capacitance of the additional electrode with respect to the resistor R_3 decreases. Thus, the alternating voltage occurring between the resistor R_3 and the additional electrode 5 is increasingly greater in direction towards the ground point 6, namely from zero volts to the maximum value U_W. Thereagainst, the alternating voltage between the resistor R_3 and the screening cylinder 4 reduces from the maximum value U_W down to zero volts. The changing capacitance of the additional electrode 5 and the likewise changing alternating voltage coupled in on the spatially extended resistor R_3 with increasing spacing from the high voltage potential point 2 generates a compensating current, which flows towards the resistor R_3 and completely replaces the current flowing away from the resistor R_3 towards the cylinder 4. By means of the additional electrode 5 there is thus prevented the arising of a part of the current which flows away from the resistor R_3 and is caused by the alternating voltage between the resistor R_3 and the screening cylinder 4 or by the parasitic capacitances, whilst the other part of this current is replaced through generation and supply of a countercurrent of equal magnitude counteracting the current flowing away.

The additional electrode 5 can, in the unwound state, have the form of a thin-layer right-angled triangle, the longer short side of which corresponds to the length of the resistor R_3 and the shorter short side of which is somewhat longer than the circular circumference of the resistor. The development of the additional electrode 5 is shown in dashed lines alongside the screening cylinder 4. In the wound state, the additional electrode 5 encircles around the resistor R_3 in such a manner that the resistor R_3 is completely surrounded in the region of the high voltage connection point 2 but is enveloped to a decreasing extent in direction towards the zero potential connection point 6. The additional electrode 5 thus encloses only the resistor R_3. The screening cylinder 4 can be provided for the resistor R_3 on its own or for both resistors R_3 and R_4, as is illustrated in Fig. 3.

CLAIMS

1. A method of compensating for parasitic capacitances between a resistor to which a voltage with alternating and direct components is applied and a screening electrode lying at zero potential and so arranged in the immediate proximity of the resistor that a current flowing away from the resistor can be generted by alternating voltage between the resistor and the electrode or by parasitic capacitances, the method comprising the steps of preventing generation of part of that current and compensating for the remaining part by generation of a current of substantially equal magnitude and opposite direction.

2. A method as claimed in claim 1 and substantially as hereinbefore described with reference to Fig. 3 of the accompanying drawings.

3. A screened resistance device comprising a resistor, a cylindrical screening electrode surrounding the resistor, and an additional electrode arranged within the screening electrode and so adapted in shape to that of the resistor that when the additional electrode lies at high potential the screening electrode has a capacitive effect on the resistor increasing to substantially the same degree as capacitive effect of the additional electrode on the resistor decreases.

4. A device as claimed in claim 3, wherein the resistor is substantially cylindrical and the additional electrode is provided by a part-cylindrical sheet of electrically conductive material which in development has the form of a right-angled triangle with one of its shorter sides extending around and being longer than the circumference of the resistor and its other shorter side extending axially of and being substantially equal in length to the resistor, the additional electrode being arranged to extend completely around the resistor circumference in the region of one end thereof connectible to a high voltage source and to extend around a progressively smaller amount of the resistor circumference in the direction of the other end of the resistor.

5. A device as claimed in either claim 3 or claim 4, comprising a further resistor connected in series with the first-mentioned resistor and means to tap a measurement voltage from the connection of the two resistors.

6. A device as claimed in claim 5, wherein the screening electrode surrounds both resistors and the addition electrode extends around only the first-mentioned resistor.

7. A device substantially as hereinbefore described with reference to Fig. 3 of the accompanying drawings.

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